Diploma Programme
Programme du diplôme
Programa del Diploma

Environmental systems and societies
Standard level
Paper 1

Friday 3 November 2017 (afternoon)

1 hour

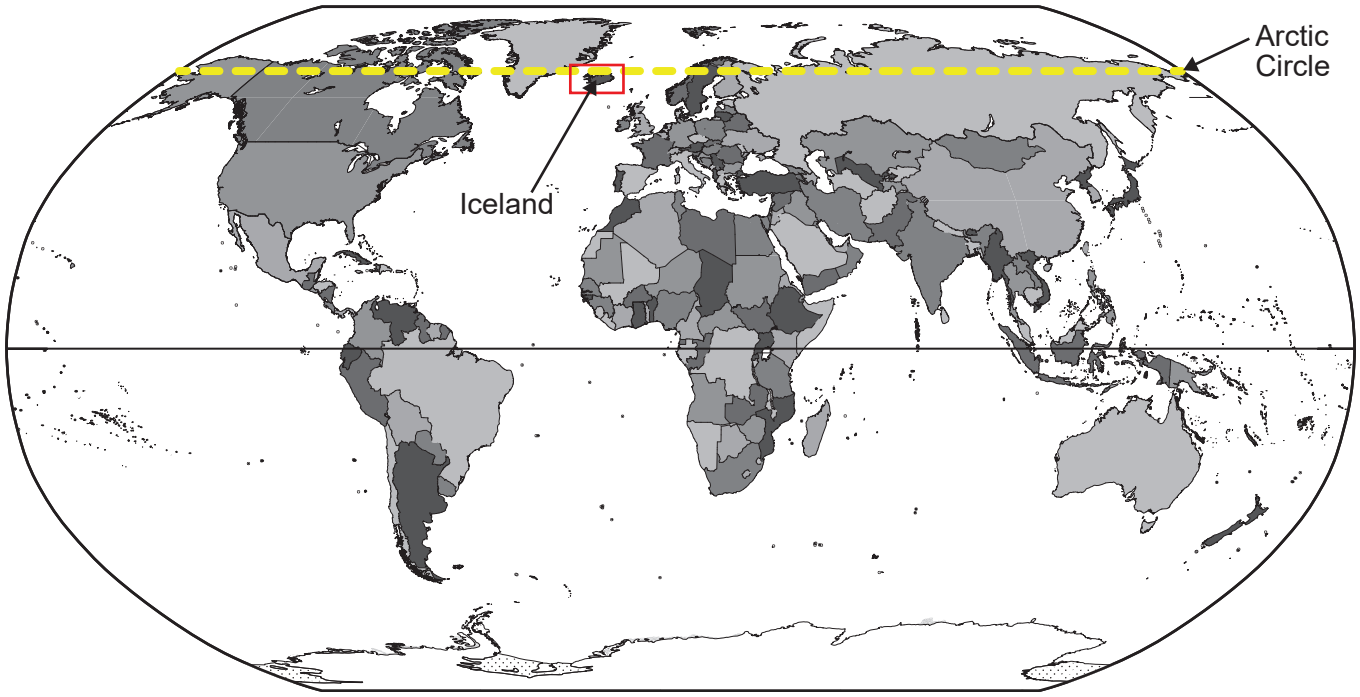
Resource booklet

Instructions to candidates

- Do not open this booklet until instructed to do so.
- This booklet contains all the resources required to answer paper 1.

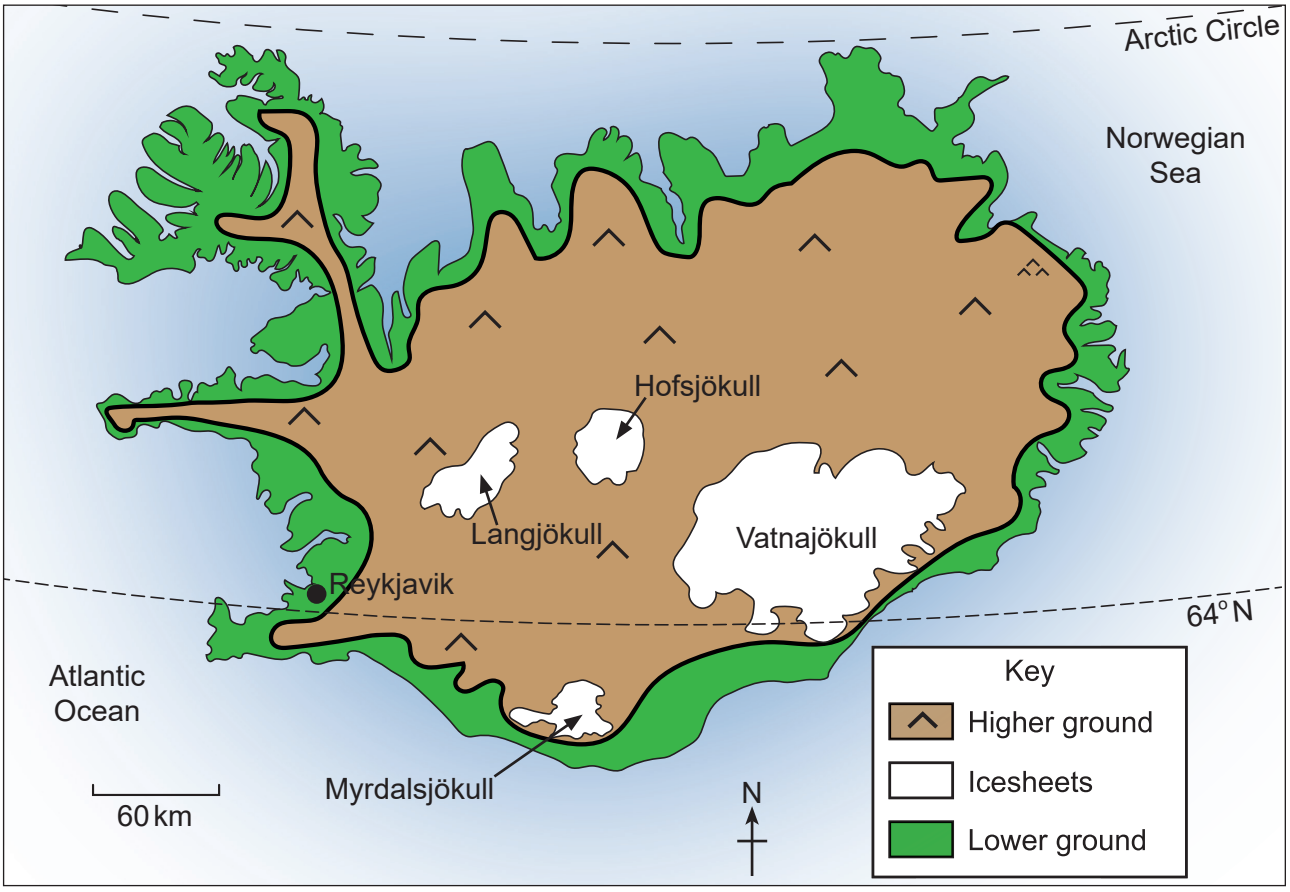
8817 – 6302

Figure 1(a): Map showing the location of Iceland



[Source: adapted from CIA World Factbook]

Figure 1(b): Map showing the main features of Iceland



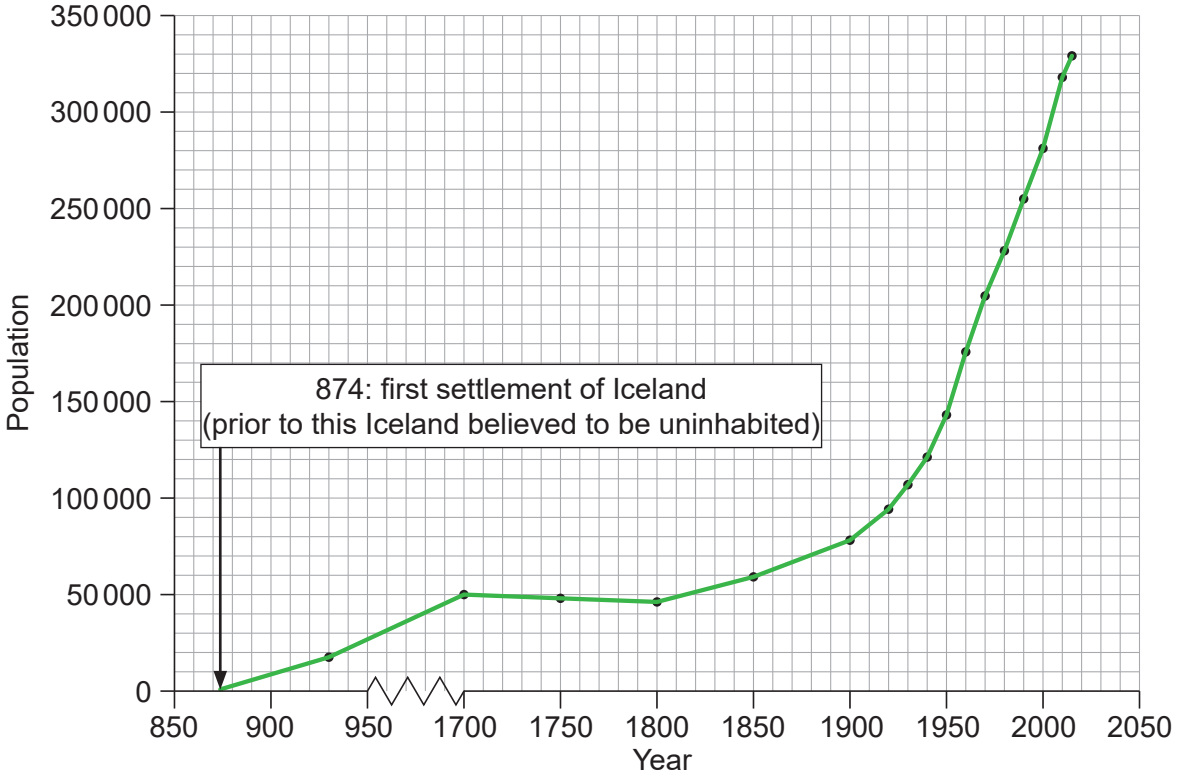
[Source: © International Baccalaureate Organization 2017]

Figure 2: Fact file on Iceland

- Land area of 103 000 km^2.
- Terrain is mountainous and volcanic.
- Isolated island so biological diversity is low, and there are few endemic species.
- Only 0.7 % of land is suitable for growing crops, and harsh climate means farming is limited to livestock and geothermally-heated greenhouses.
- 60 % of population live in the capital city Reykjavik.
- Total fertility rate is two children per woman.
- Important industries include fishing, aluminum smelting and tourism.
- Ecological footprint is 7.4 GHa compared to a world average of 2.6 GHa.
- A representative democracy and high income country, ranked 13th highest on the human development index.
- Badly affected by the global financial crisis in 2008.
- Hydroelectric and geothermal power sources provide 85 % of primary energy.
- Expects to be energy-independent, using 100 % renewable energy by 2050.
- Government recently approved oil exploration in Icelandic waters by oil companies.

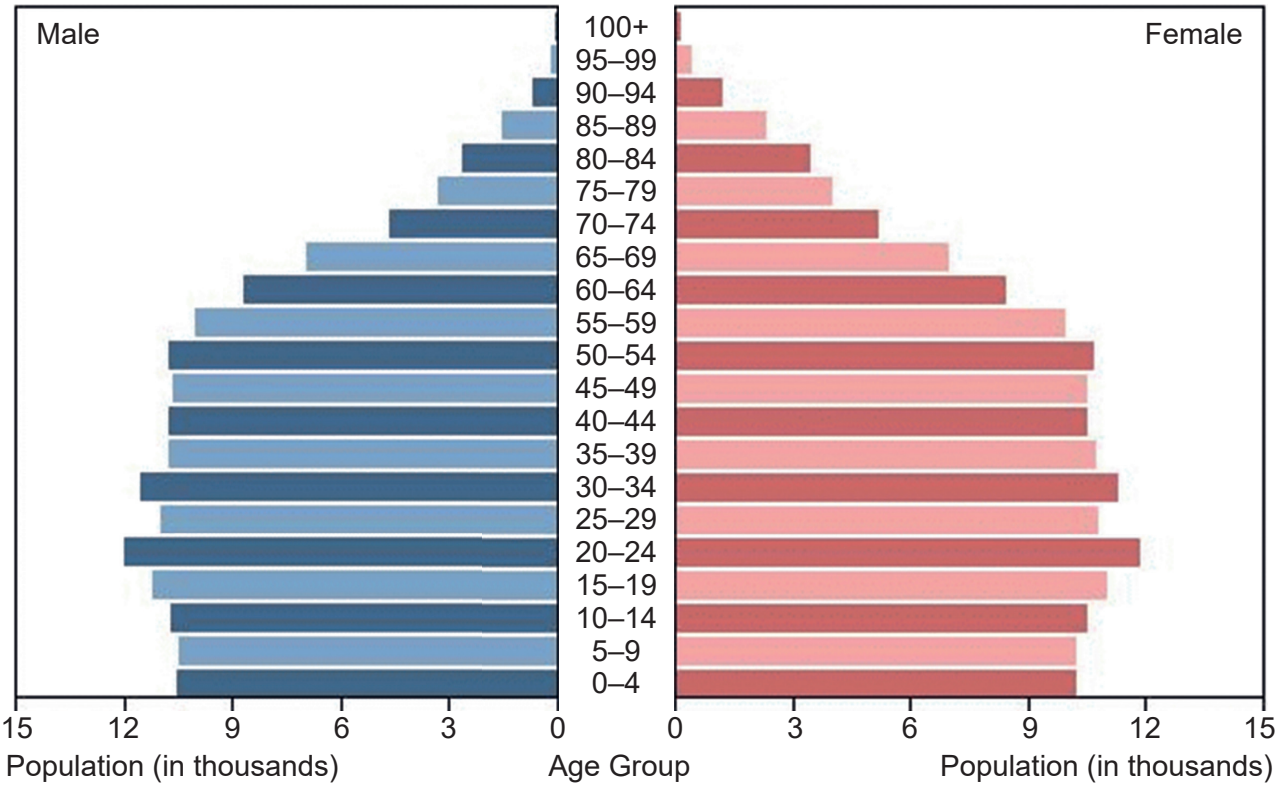
[Source: Open access/Wikipedia]

Figure 3(a): Graph showing Icelandic population change over time



[Source: adapted from Statistics Iceland, www.statice.is]

Figure 3(b): Age-gender pyramid for Iceland in 2014

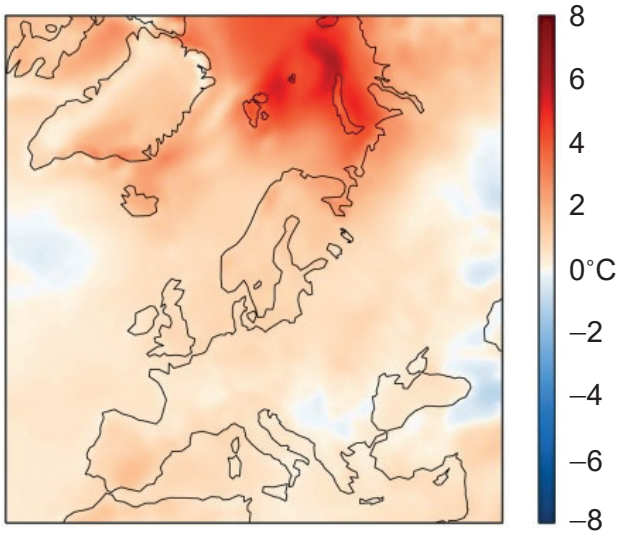


[Source: www.indexmundi.com]

Figure 4(a): Climate graph for Reykjavik, Iceland

Removed for copyright reasons

Figure 4(b): Surface air temperature anomaly for May 2016 to April 2017 relative to the average for 1981-2010



[Source: ECMWF Copernicus Climate Change Service]

Figure 5: Photographs showing Icelandic flora and fauna

Invasive lupin
(*Lupinus nootkatensis*)

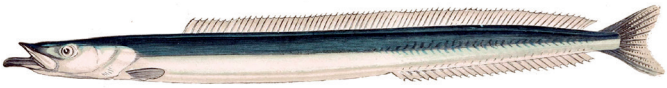
[Source: https://en.wikipedia.org/wiki/Lupinus_nootkatensis#/media/File:Lupinus_nootkatensis_-_Iceland_20070706b.jpg. Photo taken by user JuTa, see https://creativecommons.org/licenses/by-sa/3.0/legalcode]

Atlantic puffin and burrow
(*Fratercula arctica*)

[Source: Sebastian Kennerknecht/ Minden Pictures/ Getty Images]

Atlantic herring
(*Clupea harengus*)

[Source: https://en.wikipedia.org/wiki/Atlantic_herring#/media/File:Clupea_harengus.png]



Great sand eel
(*Hyperoplus lanceolatus*)

[Source: https://en.wikipedia.org/wiki/Great_sand_eel#/media/File:Hyperoplus_lanceolatus.jpg]

(This figure continues on the following page)

(Figure 5 continued)

Native birch trees in Iceland
(*Betula pubescens*)

[Source: https://en.wikipedia.org/wiki/Montane_ecosystems#/media/File:Mountain-birch-Trollheimen.jpg, by Orcaborealis. Licensed here: https://creativecommons.org/licenses/by-sa/3.0/legalcode.]

Arctic fox
(*Vulpes lagopus*)

[Source: https://commons.wikimedia.org/wiki/File:Arctic_fox_(6375703941).jpg, photo taken by Emma J. Bishop, see https://creativecommons.org/licenses/by/2.0/legalcode.]

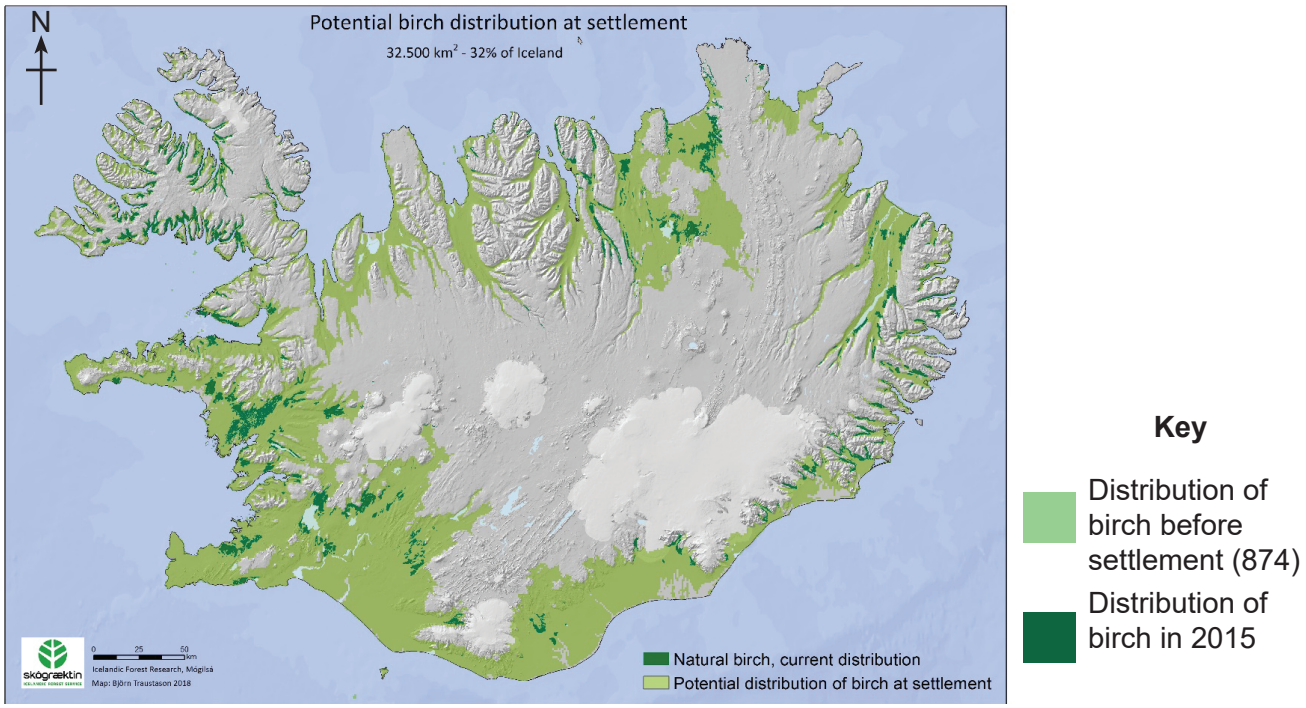
Atlantic mackerel
(*Scomber scombrus*)

[Source: https://en.wikipedia.org/wiki/Atlantic_mackerel#/media/File:A_mackerel.jpg, photo taken by Peter van der Sluijs, see https://creativecommons.org/licenses/by-sa/3.0/legalcode.]

Picture removed shows puffin hunter in Iceland using a sky fishing net

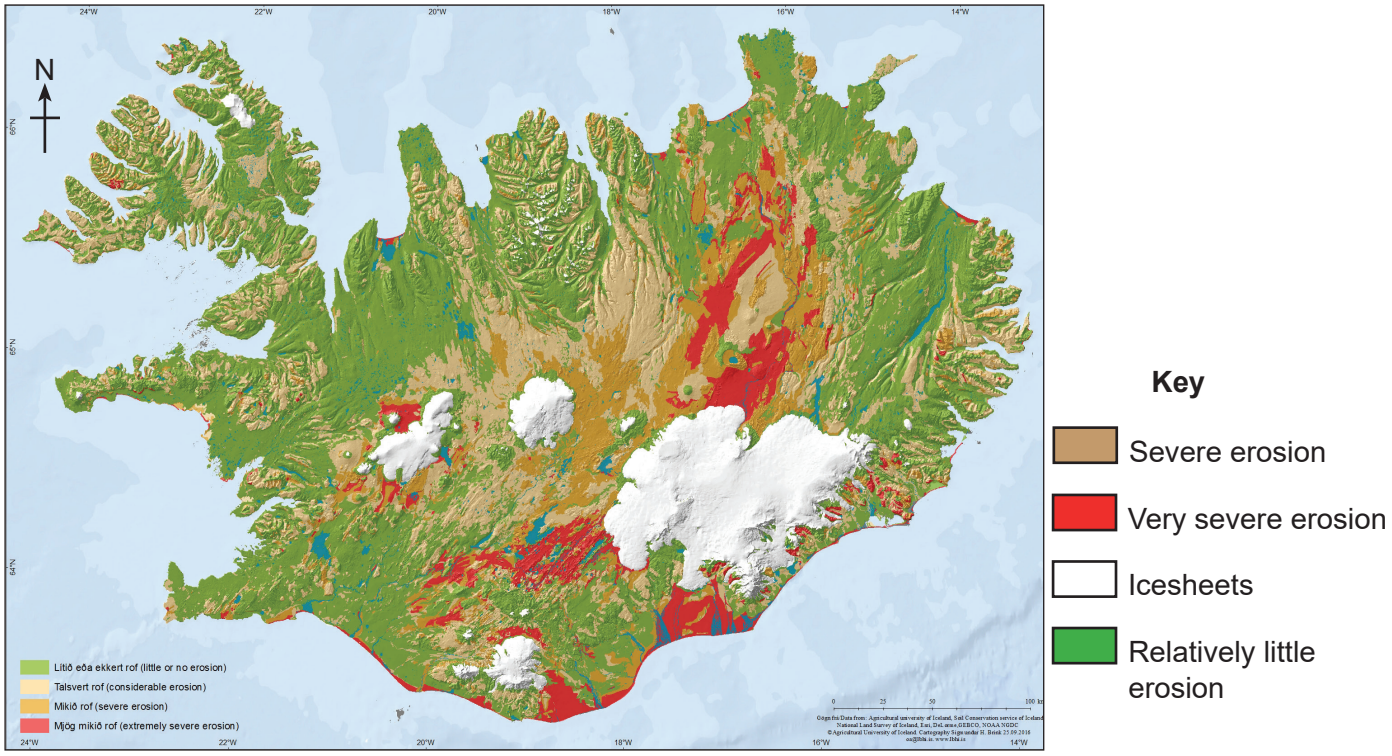
Puffin hunter in Iceland

Figure 6(a): Map showing distribution of birch forest in 874 and in 2015



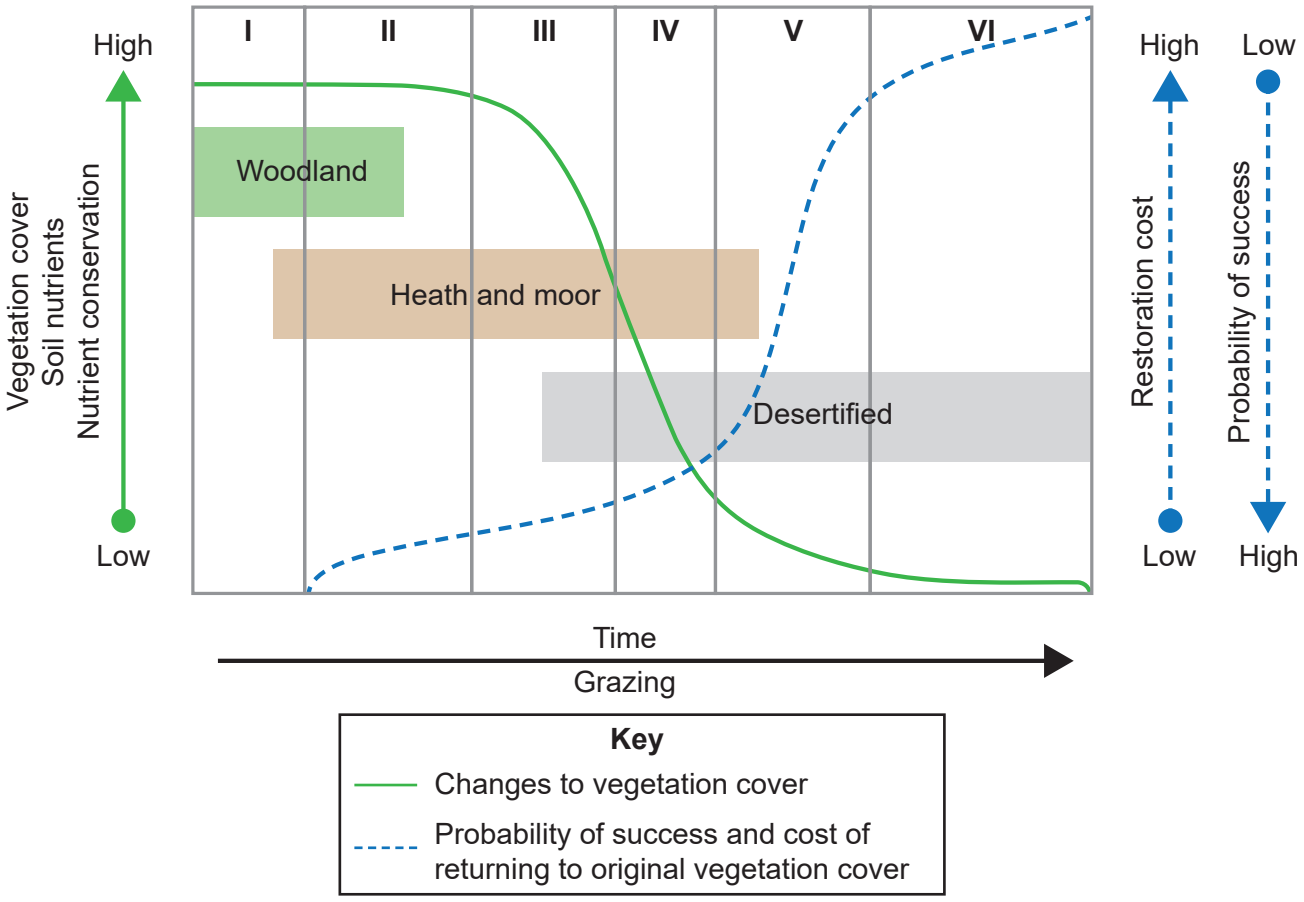
[Source: Map drawn by Icelandic Forest Service (www.skogur.is). Used with permission.]

Figure 6(b): Map showing soil erosion in Iceland in 2007



[Source: adapted from www.rala.is]

Figure 6(c): Model to show changes in vegetation cover during the six stages of soil degradation in Iceland



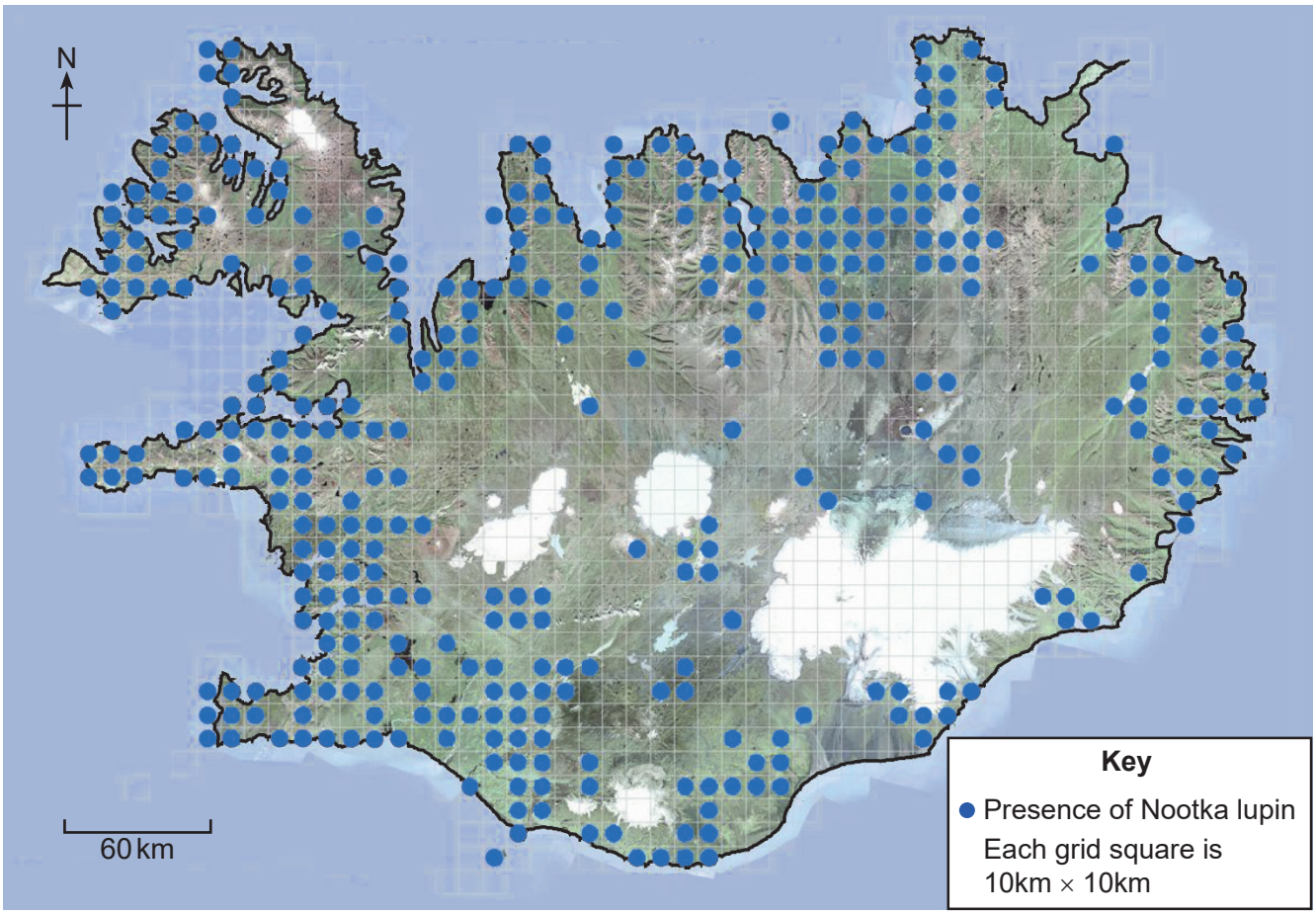
[Source: adapted from Aradottir, A.L. *et al*., (1992), *Hnignun gróðurs og jarðvegs*. (A model for land degradation. In Icelandic.) *Grœðum Island* (Yearbook of the Soil Conservation Service), (4), pages 3–82]

Figure 7(a): Fact file on Nootka lupin

- Native to North America.
- Introduced in Iceland to stop soil erosion in 1885.
- Invasive – spread quickly and outcompetes native flora.
- Ministry of Environment recommended eradication of the lupin in highlands (above 400 m), national parks and conservation areas.
- Removal methods include: grazing, use of herbicides, pulling up by hand, mowing.
- Public participation encouraged to help with removal of the lupin.

[Source: Icelandic Institute of Natural History]

Figure 7(b): Known distribution of lupin in 2010



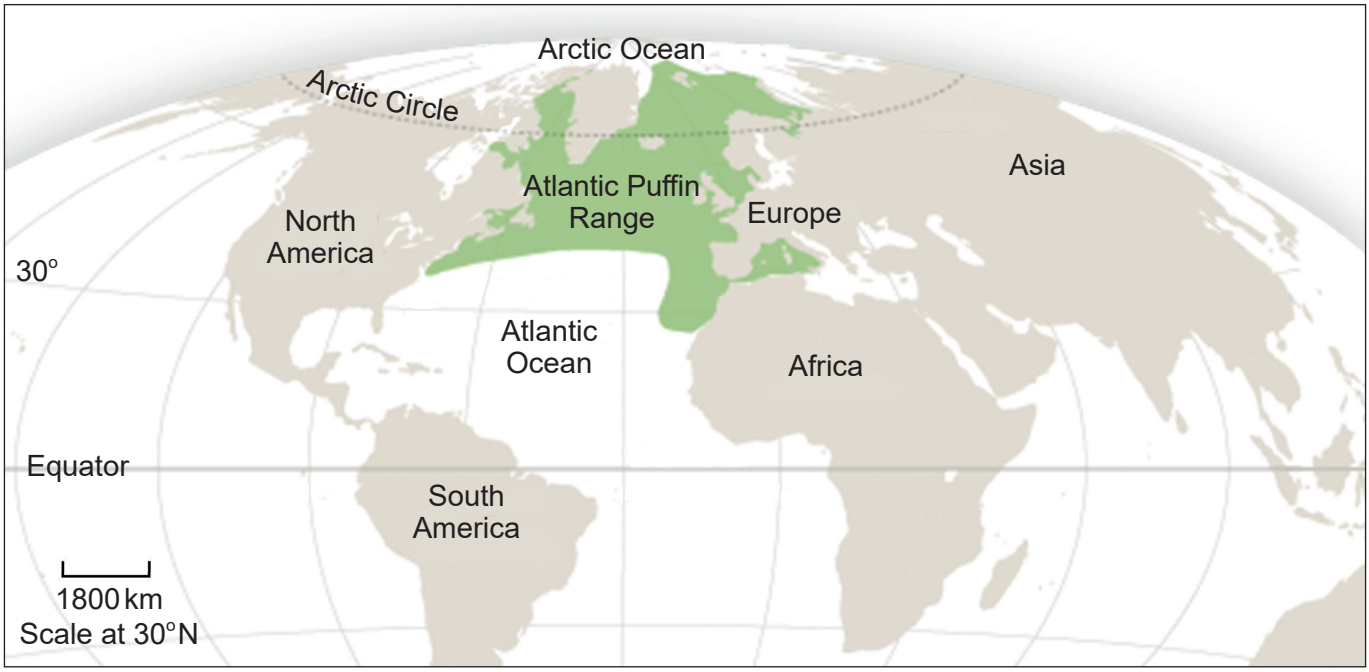
[Source: Icelandic Institute of Natural History]

Figure 8(a): Fact file on the Atlantic puffin

- Estimated worldwide population of twelve million.
- 60 % of the world's puffins live in Iceland.
- Puffins lay their eggs in burrows on cliffs in June–July, one egg per year.
- Adult puffins bring small fish to their young.
- Classified as "vulnerable" on International Union for Conservation of Nature (IUCN) red list.
- Current population in decline.
- Threats to puffins include overfishing, native predators such as foxes and gulls, introduced predators such as cats, hunting and egg collection by humans, oil spills, extreme weather and disturbance from tourists.
- Puffins can be hunted legally in Iceland in April by a technique called "sky fishing", which involves catching low-flying birds with a big net. Their meat and eggs are commonly featured on hotel menus.
- Puffin populations affected by extreme weather events, and changes in availability of food.

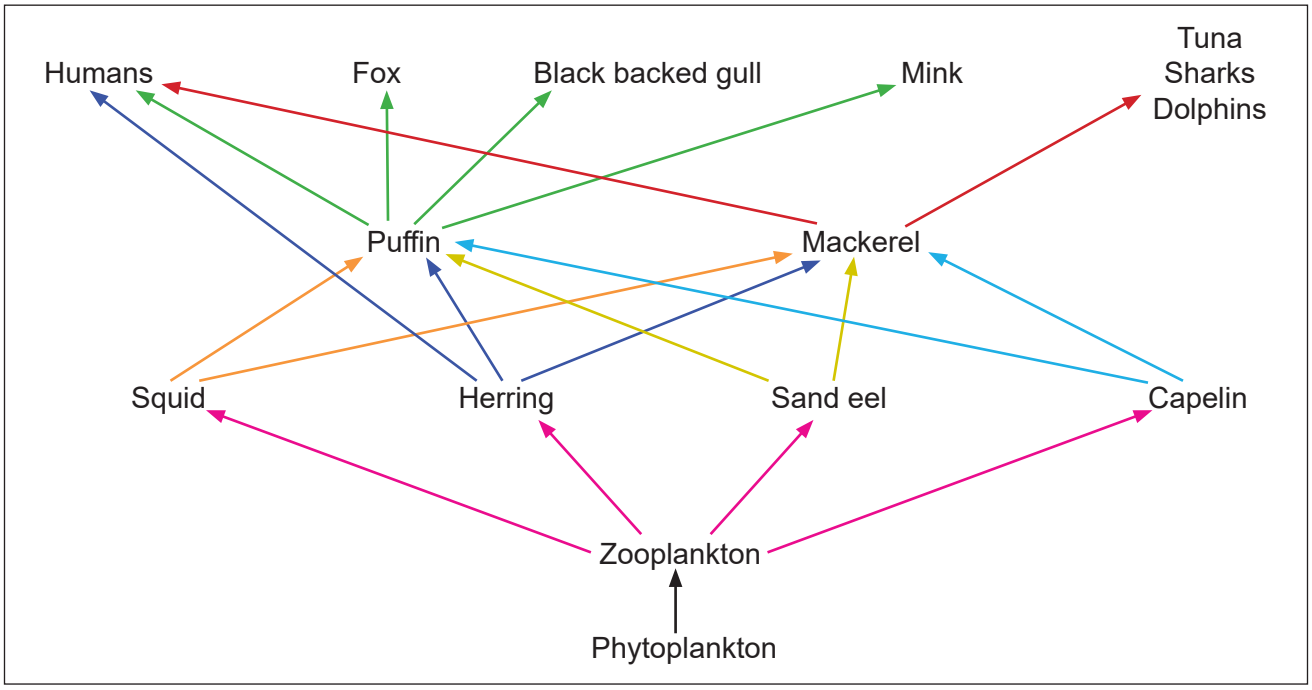
[Source: Adapted from: https://en.wikipedia.org/wiki/Puffin#cite_note-BNA_Atlantic-21]

Figure 8(b): Atlantic puffin range



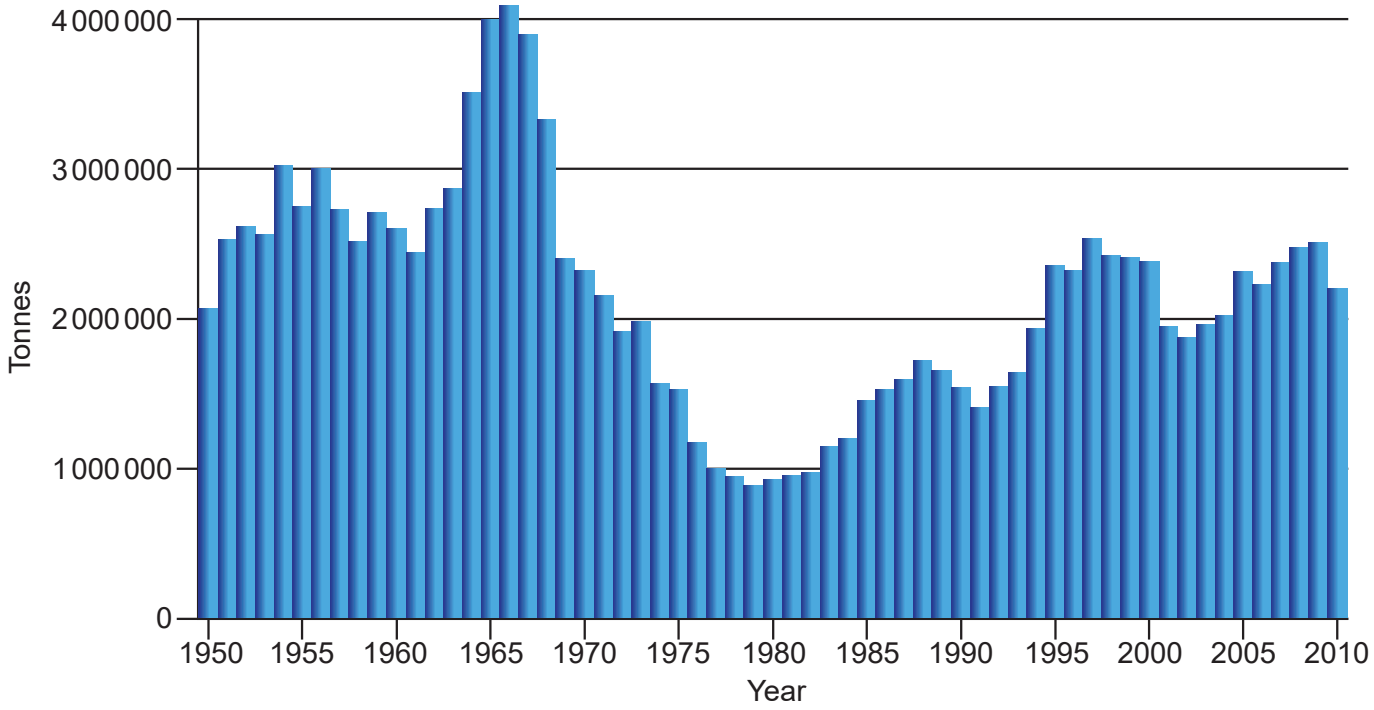
[Source: Adapted from: National Geographic Creative, http://ngm.nationalgeographic.com/2014/06/puffins/img/atlantic-puffin-range-map-525.png]

Figure 8(c): Food web for the Atlantic puffin



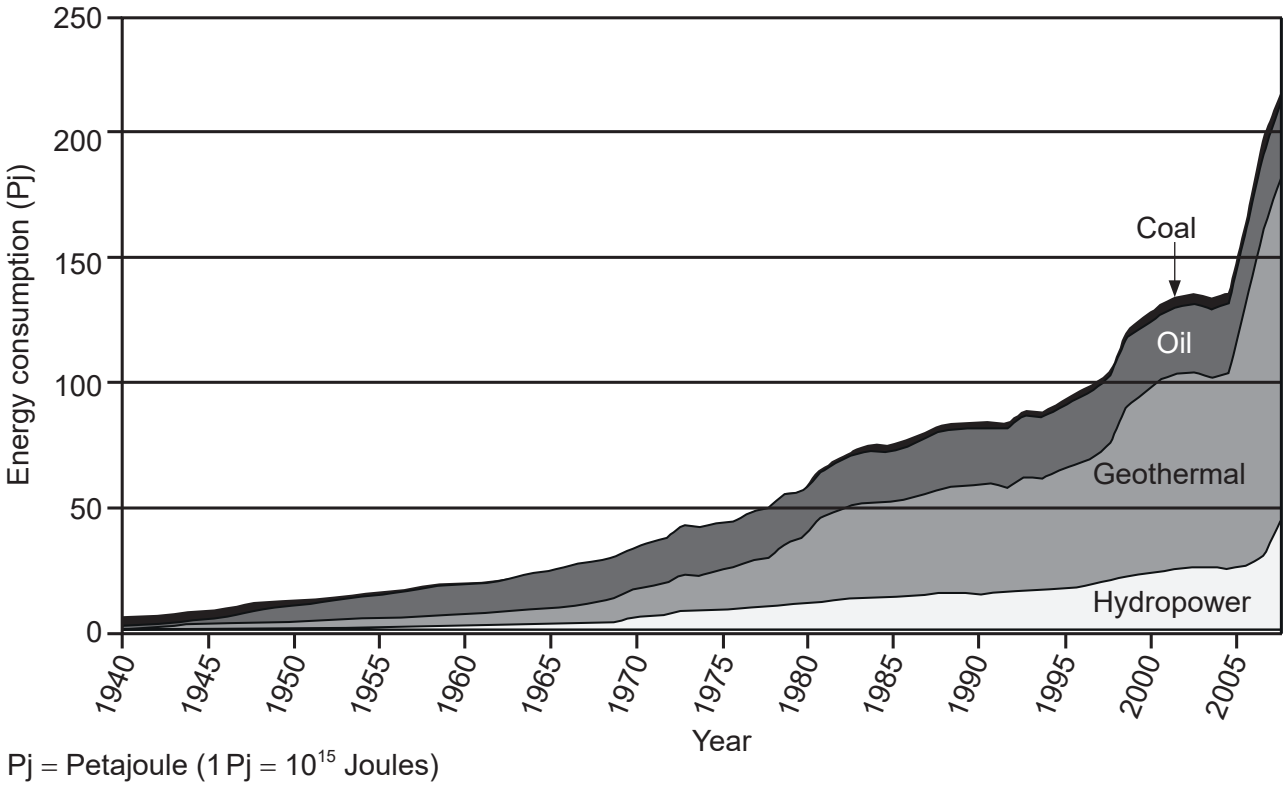
[Source: © International Baccalaureate Organization 2017]

Figure 8(d): Graph showing global capture fisheries of Atlantic herring in tonnes 1950–2010



[Source: FAO Fishstat / https://en.wikipedia.org/wiki/Atlantic_herring#Baltic_herring]

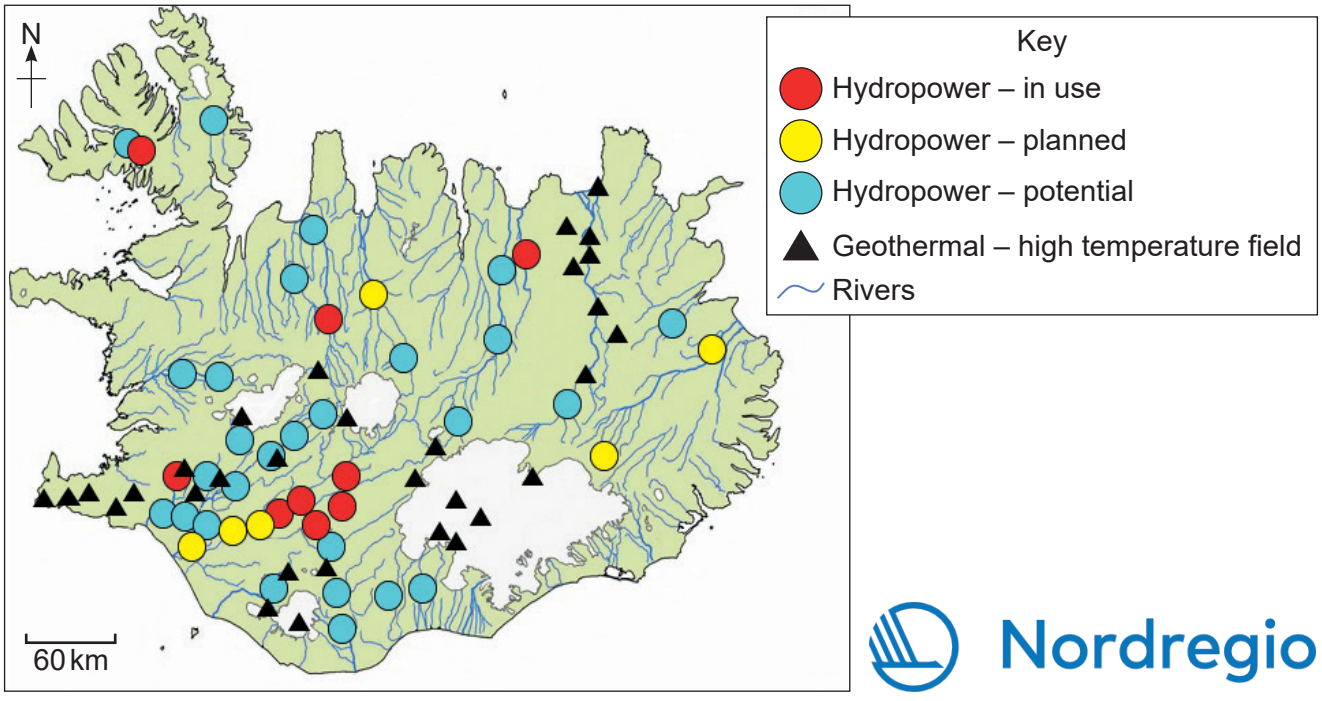
Figure 9(a): Graph showing primary energy consumption in Iceland 1940–2008



Pj = Petajoule (1 Pj = 10^{15} Joules)

[Source: Energy Agency of Iceland]

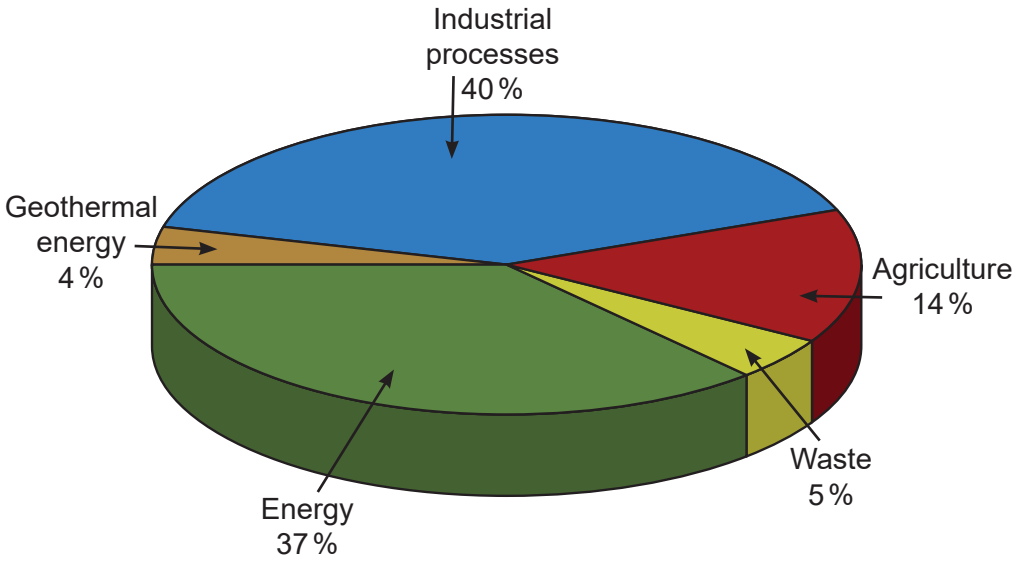
Figure 9(b): Map showing hydropower and geothermal energy resources in Iceland



[Sources: Map of hydropower potentials, produced by Nordregio based on similar produced by Landsvirkjun, Iceland's state-owned national power company and Energy in Iceland, published by the National Energy Authority / Ministry of Industry and Commerce, Reykjavik, September 2006]

Turn over

Figure 9(c): Pie chart showing sources of greenhouse gas emission in Iceland in 2010



[Source: Environment Agency of Iceland National Inventory Report 2012]